

I CLAIM:

1. A driver circuit suitable for use in an electro-optical modulator driver, comprising:

an output stage, comprising:

first and second bipolar transistors
5 arranged as a first differential pair, the emitters of said transistors connected together at a first common node, said first transistor's collector coupled to ground;

a first current source connected between
said first common node and a first supply voltage which
10 provides bias current to said first differential pair;

said second transistor's collector coupled
to a second supply voltage via an impedance and providing
said driver circuit's output;

a reference voltage provided to said second
15 transistor's base; and

a capacitor connected between said second
transistor's base and ground such that said second
transistor's base is at AC ground;

such that said output stage amplifies an
20 input signal applied to said first transistor's base and
provides said amplified input signal at said driver
circuit's output;

a third bipolar transistor, the base of which
provides said driver circuit's input and the emitter of
25 which is connected to said first transistor's base; and

a second current source connected between said
third transistor's emitter and said first supply voltage
which provides bias current to said third transistor, said
third transistor and second current source forming an
30 emitter-follower circuit which presents a low impedance to
said first transistor's base.

2. The driver circuit of claim 1, wherein said first transistor's collector is coupled to ground via a diode.

3. The driver circuit of claim 1, further comprising a bias-T network having a DC input, a signal input and an AC output, said bias-T network connected at its signal input to said driver circuit's output and connected at its
5 DC input to a supply voltage.

4. The driver circuit of claim 3, further comprising an electro-optical modulator connected at its electrical input to said bias-T network's AC output.

5. The driver circuit of claim 4, wherein said electro-optical modulator is a single-ended Mach-Zehnder modulator.

6. The driver circuit of claim 1, wherein said first current source is arranged such that its output current can be varied in response to a control signal to adjust the output voltage swing of said output stage's output.

7. The driver circuit of claim 1, further comprising:

a fourth bipolar transistor, the emitter of which is connected to said third transistor's base; and

5 a third current source connected between said fourth transistor's emitter and said first supply voltage which provides bias current to said fourth transistor, said fourth transistor and third current source forming an emitter-follower circuit which presents a low impedance to
10 said third transistor's base;

fifth and sixth bipolar transistors arranged as a second differential pair, the emitters of said fifth and

sixth transistors connected together at a second common node; and

- 15 a fourth current source connected between said second common node and said first supply voltage which provides bias current to said second differential pair, the collectors of said fifth and sixth transistors coupled to ground via respective resistances and the base of said
20 fourth transistor connected to the collector of one of said fifth and sixth transistors to form a driver stage, the bases of said fifth and sixth transistors providing differential inputs for said driver stage.

8. The driver circuit of claim 7, wherein said first current source is arranged such that its output current can be varied in response to a control signal to adjust the output voltage swing of said driver circuit's output, and
5 at least one of said second and fourth current sources is arranged such that their output currents vary with the output current of said first current source.

9. The driver circuit of claim 7, further comprising a reference voltage generator circuit which provides said reference voltage to said second transistor's base, said reference voltage generator circuit arranged to replicate
5 the DC bias voltage provided to the base of said first transistor and to provide said replicated voltage as said reference voltage.

10. The driver circuit of claim 9, wherein said reference voltage generator circuit comprises:

 a resistor connected between ground and a third common node;

5 a fifth current source connected between said third common node and said first supply voltage;

 a ninth bipolar transistor, the base of which is

connected to said third common node;

10 a sixth current source connected between said ninth transistor's emitter and said first supply voltage which provides bias current to said ninth transistor, said ninth transistor and sixth current source forming an emitter-follower circuit;

15 a tenth bipolar transistor, the base of which is connected to the emitter of said ninth transistor; and

a seventh current source connected between said tenth transistor's emitter and said first supply voltage which provides bias current to said tenth transistor, said tenth transistor and seventh current source forming an
20 emitter-follower circuit, the emitter of said tenth bipolar transistor providing said reference voltage.

11. The output stage of claim 10, wherein said tenth and ninth bipolar transistors are scaled with respect to said third and fourth transistors, respectively, and said fifth and seventh current sources are scaled with respect
5 to said fourth and second current sources, respectively.

12. The output stage of claim 1, wherein said impedance comprises a resistance which provides a back termination resistance for a load driven by said output stage.

13. The output stage of claim 12, wherein said impedance further comprises a shunt-peaking inductor connected in series with said resistance.

14. The output stage of claim 1, wherein said output stage is fabricated on a coplanar waveguide (CPW) layout, comprising:

5 a plurality of signal paths;
a ground plane electrically isolated from and

surrounding said signal paths and forming a coplanar waveguide (CPW) with said signal paths;

wherein said first transistor comprises a plurality of transistors connected in parallel, with their bases connected to a first signal path, their emitters connected to a second signal path, and their collectors coupled to said ground plane, said first transistor's constituent transistors arranged symmetrically about said second signal path; and

said second transistor comprises a plurality of transistors connected in parallel, with their bases connected to said capacitor, their emitters connected to said second signal path, and their collectors connected to a third signal path, said second transistor's constituent transistors arranged symmetrically about said third signal path.

15. The output stage of claim 14, wherein said capacitor is divided into two halves which are arranged symmetrically about said third signal path, and said resistance is provided by a resistor divided into two halves which are arranged symmetrically about said third signal path.

16. The output stage of claim 14, wherein said second transistor's constituent transistors are arranged such that none of their collector terminals overlaps any of their base terminals.

17. A electro-optical modulator driver, comprising:
first and second bipolar transistors (M5,M6) arranged as a first differential pair, the emitters of said first and second transistors connected together at a first common node;

a first current source (54) connected between

said first common node and a first supply voltage which provides bias current to said first differential pair, the collectors of said first and second transistors coupled to
10 ground via respective resistances, the bases of said first and second transistors providing differential inputs for said driver circuit;

a third bipolar transistor (M4) having its base connected to the collector of one of said first and second
15 transistors;

a second current source (48) connected between said third transistor's emitter and said first supply voltage which provides bias current to said third transistor, said third transistor and second current source
20 forming an emitter-follower circuit;

a fourth bipolar transistor (M3), the base of which is connected to the emitter of said third transistor;

a third current source (46) connected between said fourth transistor's emitter and said first supply
25 voltage which provides bias current to said fourth transistor, said fourth transistor and third current source forming an emitter-follower circuit;

fifth and sixth bipolar transistors (M1,M2) arranged as a second differential pair, the emitters of
30 said transistors connected together at a second common node;

a fourth current source (44) connected between said second common node and said first supply voltage which provides bias current to said first differential pair;

35 said fifth transistor's collector coupled to ground via a diode (38) and said fifth transistor's base connected to the emitter of said fourth transistor;

said sixth transistor's collector coupled to a supply voltage via a resistance;

40 a reference voltage provided to said sixth transistor's base;

a capacitor connected between said sixth transistor's base and ground such that said sixth transistor's base is at AC ground; and

45 a bias-T network having a DC input, a signal input and an AC output, said bias-T network connected at its signal input to said sixth transistor's collector and connected at its DC input to a supply voltage, said bias-T network's AC output providing said driver circuit's output;
50 such that said driver circuit amplifies a differential input signal applied to said differential inputs and provides said amplified input signal as a single-ended output signal at said driver circuit's output.

18. The driver of claim 17, further comprising an electro-optical modulator connected at its electrical input to said bias-T network's AC output.

19. The driver of claim 18, wherein said electro-optical modulator is a single-ended Mach-Zehnder modulator.

20. The driver of claim 17, wherein said fourth current source is arranged such that its output current can be varied in response to a control signal to adjust the output voltage swing of said driver circuit's output.

21. The driver circuit of claim 17, further comprising a reference voltage generator circuit which provides said reference voltage to said sixth transistor's base, said reference voltage generator circuit arranged to
5 replicate the DC bias voltage provided to the base of said fifth transistor and to provide said replicated voltage as said reference voltage.

22. The driver circuit of claim 17, wherein said resistance provides a back termination resistance for the

load driven by said output stage.